THE ROLE OF KNOWLEDGE AND CAPABILITIES IN A SUSTAINABLE PRODUCT CHAIN CONTEXT - A LITERATURE REVIEW

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ABSTRACT

Sustainable development is a huge contemporary environmental challenge and a topic that has been widely discussed over the last decades. Managing environmental issues organizations has traditionally had an 'in-house' environmental focus, but attention has more and more turned from these in-house environmental aspects towards an approach where environmental concern is extended to include the life cycle of a product. There is a diversity of concepts that relate to environmental concern and sustainability of products and supply chains. But all in all the common denominator of this perspective is environmental consideration that stretches the traditional focus on individual actors towards a holistic environmental product chain perspective - here referred to as a 'sustainable product chain' perspective. Focus in this body of literature is on having a broader environmental perspective and interactions with actors upstream and downstream the product chains, therefore a number of authors within this field have also focused on the sharing of knowledge, resources and organizational capabilities within and between product chain actors. Knowledge as an academic field is vast and contains numerous different directions and there are several ways of viewing and understanding knowledge. As knowledge and organizational capabilities for sustainable product chains is a young and emerging field this has prompted a literature review with the aim of exploring which knowledge perspectives are dominant in the literature on knowledge and organizational capabilities in sustainable product chains. and to examine its role in a sustainable product chain context. The review shows that the field is dominated by assumptions that knowledge is something that can be created, and transferred from one party to another, similar to an object. Thus, knowledge is treated in a rather simplistic matter.

1. SUSTAINABLE PRODUCT CHAINS

Sustainable development is a huge contemporary environmental challenge (WCED, 1987; Stern, 2007) and a topic that has been widely discussed over the last decades. Sustainable development, as defined in the Bruntland report, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). This means to have a more holistic perspective on environmental, social and economic aspects of

development. Organizations has traditionally had an 'in-house' environmental focus, on mainly own facilities and activities, including e.g. internal issues regarding environment, health and safety (EHS) and environmental management systems (EMS) (Welford, 1996/1998). This is often referred to as environmental management (EM), which Füssel (2005) define as "being the objectives, standards, procedures and practices that a company establishes to manage environmental challenges (p. 51). Or as Hofmann et al. (2012) put it; "a systematic administrative approach to reducing or eliminating the damage created by a firm to the natural environment in which it operates" (p. 2). EM does thus focus mainly on individual companies and actors.

But there has been criticism towards this way of mainly focusing environmental concern towards internal company aspects. Welford (2003) questioned whether internally focused environmental actions, such as EMS, are adequate to manage the complexity that today's global trade implies and pointed out that EMS might only shift environmental load from one actor to another, further up or downstream in the product chains. A more holistic perspective is therefore considered to be needed. Attention has though more and more turned from in-house environmental aspects towards an approach where environmental concern is extended to include the life cycle of a product (Kolk, 2000).

In environmental life cycle literature several related concepts are used, such as life cycle management (LCM), sustainable supply chain management (SSCM), green supply chain management (GSCM) et cetera. Vermeulen and Seuring (2009) stated that supply chain related concepts derive from business management and that issues relating to the life cycle of products instead derive from the environmental sciences. To be more precise concepts such as SSCM and GSCM et cetera stem from conventional supply chain literature that focus mainly on upstream actors, whilst LCM literature is based on a cradle-to-grave approach and therefore has a wider product chain reach (Seuring, 2004). The cradle-to grave approach is the basis of life cycle assessment (LCA), a method and tool often used to identity where environmental hotspots are located in the product chain. Baumann and Tillman (2004) define it as a tool where "natural resource use and pollutant emission are described in quantitative terms (p. 19) and describes that "it means that a product is followed from its 'cradle' where materials are extracted from natural resources through production and use to its 'grave', the disposal" (p. 19). LCM and LCA are

therefore based on the same grounds, but LCM concerns the management of the cradle-to-grave approach, whilst LCA is the actual method to calculate environmental load.

The body of literature within this perspective highlights a holistic perspective and that environmental consideration should directed towards the whole life cycle of a product (Linnanen et al., 1995; Westkämper et al., 2000; Hunkeler et al., 2003; Baumann & Tillman, 2004; Remmen et al., 2007; UNEP & SETAC, 2009). The aim of LCM is to decrease the environmental load related to a product during its life cycle (Hunkeler et al., 2003; Remmen et al., 2007). Interaction and collaboration between upstream and downstream actors is often pointed out as essential (Westkämper et al., 2000; Baumann & Tillman, 2004) since attention is on managing environmental issues between companies or other actors related in a product chain.

Also within these environmentally related concepts there are several variations. To take LCM as an example, it can be defined as "an integrated framework of concepts and techniques to address environmental, economic, technological and social aspects of products, services and organizations" (Hunkeler et al., 2003, p. 69) or as "the managerial practices and organizational arrangements that apply life cycle thinking. This means that environmental concerns and work are coordinated in the whole life cycle instead of being independent concerns in each company" (Baumann and Tillman, 2004, p. 62). There are several more definitions like this, displaying a spectrum of variations. Poikkimäkki (2006) highlighted this, concluding that theoretical LCM descriptions "can cover any environmental considerations in a company or among several companies along a product life cycle, from an entirely new management paradigm to a certain perspective and to the use of specific tools" (p. 49).

As described there is a diversity of concepts that relate to environmental concern and sustainability of products and supply chains. All in all the common denominator of this perspective is environmental consideration that stretches the traditional focus on individual actors towards a holistic environmental product chain perspective. These concepts are therefore hereon referred to as a 'sustainable product chain' perspective. Since focus in this body of literature is on having a broader environmental perspective and interactions with actors upstream and downstream the product chains a number of authors within this field have also focused on the sharing of knowledge, resources and organizational capabilities within and between product

chain actors. Knowledge as an academic field is vast and contains numerous different directions and there are several ways of viewing and understanding knowledge. As knowledge and organizational capabilities for sustainable product chains is a young and emerging field this has prompted a literature review with the aim of exploring which knowledge perspectives are dominant in the literature on knowledge and organizational capabilities in sustainable product chains and to examine the role of knowledge and capabilities in a sustainable product chain context.

2. TWO MAIN PERSPECTIVES ON KNOWLEDGE

Since the question in focus here is to develop an understanding of capabilities and knowledge for sustainable product chains it is necessary to study the different viewpoints that exist within the knowledge field. Crudely speaking one can say that there are two broad main perspectives within this field and proponents of each perspective have different underlying assumptions (Alvesson & Kärreman, 2001; Diedrich, 2004; Hislop, 2005/2009).

One of these perspectives is what is here referred to as knowledge management (KM). Proponents of this perspective view knowledge as something that can be created or obtained and as something that can be shared, transferred and stored (Diedrich, 2004). This means that knowledge is treated more as an object, something that can be possessed by people (Cook & Brown, 1999), and that can be separated from people by codification (from tacit knowledge to explicit knowledge) (Nonaka, 1991). Nonaka (1991) describes tacit knowledge as knowledge that is "deeply rooted in action" (p. 98) and highly personal and difficult to share with others, whilst explicit knowledge is described as formal and systematic and therefore easy to share and communicate[1]. The goal of explicit knowledge is to share it with others as a way to create knowledge (Nonaka, 1991). This process can be described as including; 1) identifying relevant knowledge, 2) making tacit knowledge explicit, 3) collecting it in a system, and 3) sharing it with all relevant parties (Hislop, 2005/2009). The view on sharing of knowledge within this perspective has been visualized as the conduit model of knowledge sharing (Hislop, 2005/2009,

[1] The divide between tacit and explicit knowledge originates from the work of Polanyi (1958) (Diedrich, 2004).

p. 26) (figure 1). The idea is that explicit knowledge can be taken from one party (the transmitter) to another (the receiver) without any important information being lost in the process (Boland & Tenkasi, 1995). The task of management then becomes to find "the right tools for the job" (Clarke & Fujimura, 1992) – the tools and methods to use so that as little information is lost as possible.

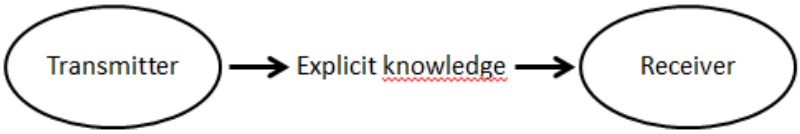

Figure 1 The conduit model of knowledge sharing, adapted from Hislop (2005/2009, p. 26)

Thus, focus in this literature with regards to knowledge sharing is often in a rather simplifying manner on tools and on 'best practices' (Diedrich, 2004). To summarize, evident features of this perspective here are that knowledge is seen rather objectively, as something that can be created, turned from tacit to explicit, separated from people, transferred to others, without any major difficulties or implications.

Proponents of another knowledge perspective instead highlight knowing as practice (Cook & Brown, 1999), as a process, and as part of people (Orlikowski, 2002, Diedrich, 2004). Hislop (2005/2009) summarized a listing of several aspects separating the practice-based perspective from the KM perspective; 1) knowledge as embedded in human activity and not something one has, (not an object) 2) tacit and explicit knowledge impossible to completely separate from each other, 3) knowledge develops from practice, activities and experience, 4) knowledge socially and culturally constructed – it is influenced by the social and cultural context by with it is created. No obvious 'name' is used for this perspective, but it is sometimes referred to as situated knowledge or learning (Brown & Duguid, 1991; Lave & Wenger, 1991) or practice-based knowing (Nicolini et al., 2003). Orlikowski (2002) used the concept organizational *knowing* instead of *knowledge* to show that it emerges from "the ongoing and situated actions of organizational members as they engage the world. It is an explanation grounded in what it is people do every day to get their work done" (p. 249), and not a thing or an element. As such it is believed to be impossible to separate from practice. Knowledge and learning instead need to be considered in its specific context and be adapted to local circumstances (Orlikowski, 2002). Proponents of this perspective are often critical towards 'best practice' and transfer of knowledge since what is 'best' in one

context might be out of place in another (Diedrich, 2004). The conduit model of knowledge sharing (figure 1) has therefore been criticized, since sharing of knowledge requires that involved parties have an understanding of each other's prior knowledge base and tacit assumptions (Boland & Tenkasi, 1995). To summarize, within the practice-based perspective knowledge is viewed rather as a process and practice inseparable from people and therefore knowledge sharing is seen as a more complex matter then sharing of explicit knowledge from one part to another.

3. ANALYSIS

The above sections have shown that there are different ways of viewing management of environmental aspect as well as different perspectives on knowledge. Focus of this review is, as mentioned, to explore which knowledge perspectives are dominant in the literature on knowledge and organizational capabilities in sustainable product chains and to examine the role of knowledge and capabilities in a sustainable product chain context. The review shows that both knowledge perspectives are present but to a varying degree.

One stream of literature in the review has adopted more of a KM perspective on knowledge. As such environmental knowledge is treated more as something to be combined, transferred, shared or stored. Focus is mainly on aspects such as environmental training and education and tools for LCM and knowledge sharing. Many of these papers revolve around resources or capabilities combined with different environmental aspects, such as capabilities and green supply (Bowen et al., 2001), sustainable supply chain management (SSCM) and inter-organizational resources (Gold et al. (2010), dynamic capabilities and corporate social sustainability (CSR) (Ramachandran, 2011), marketing capabilities and sustainable business (Mariadoss, 2011), organizational resources and voluntary sustainability initiatives (Peters et al., 2011), dynamic capabilities and SSCM (Beske, 2012), determinant factors for green supply chain management (GSCM) activities (Liu et al., 2012). Capabilities are thus frequently mentioned, whereas knowledge sharing is more implicitly related to, but generally in these papers capabilities and knowledge is treated more as an object, something that can be learnt and shared between people and places. Cheng et al. (2008) provide a paper explicitly on knowledge sharing in green supply chain management (GSCM) focusing on trust as a factor of focus. But also here knowledge is

viewed in a more simplistic way and not discussed in any detailed way. Tools are also a frequent topic of KM related literature, e.g. Herreborg Jørgensen (2008) discusses the importance of integrated sustainable management systems, and de Bakker & Nijhof (2002) provide a model that is stated to help firms develop organizational capabilities for responsible chain management. The model is stated to be applicable to many organizations, but again there is no discussion of difficulties or complexity related to such usage. To summarize, literature in this stream treats knowledge more as an object and lacks focus on local context and adaptation, and on how learning and sharing actually take place in different contexts.

Another stream of literature in the review has instead of an obvious KM perspective adopted more of a knowing as practice perspective. Swarr and Fava (2007) describe what they call a capability maturity model (CMM) for life cycle management, which is a tool for sustainability strategy with steps that an organization can use to assess its own performance. The authors stress that there is no 'one size fits all' when it comes to sustainability strategies but rather that organizations must adapt standard tools to their own organizations local environment. The CMM is described as a LCM tool that should be adapted to the local context of the organization. Workshops where participants actively engage in networking and problem-solving is also emphasized by the authors. (Swarr & Fava, 2007) Swarr et al. (2011) developed the view on the CMM for LCM further and described that the model can help in establishing a common vision for the organization and to help set priorities for action. The aim of the model is described to be to simplify decision making processes and organizational assessment. It is explained to help in establishing a common vision for the organization and to help set priorities for action. The authors' stress that it is the possibility to adapt the model to the local context and to own values and priorities that enables users to make effective decisions. (Swarr et al., 2011) In his paper on co-management and environment Berkes (2009) stated that when successful co-management is a knowledge partnership. It is stated to be a possibility for joint decision-making by involved parties within and outside of the organization. This way of bridging organizations thus provide a platform for interaction between parties with different kinds and scales of knowledge as well as provides networking possibilities. (Berkes, 2009) Lenox and Ehrenfeld's (1997) focus is on capabilities for environmental design and environmental consideration into product development. In the paper the authors stated that such capabilities derive from integration of knowledge from different parties, through communication and networking. What is highlighted is the importance

of not only gaining resources and communicating but to really understand the information communicated - environmental information can not only be transmitted, it has to be understood. The everyday interaction between members with different knowledge bases is also emphasized. (Lenox & Ehrenfeld, 1997) In their paper on sustainable business management and capabilities for innovation van Kleef and Roome (2007) put a lot of attention on collaboration of different sorts. Multi-actor collaboration is suggested, as it e.g. involves learning and builds context-dependent knowledge. To collaborate in teams with diverse knowledge bases, to network and to manage relationships are some of the important capabilities discussed.

The papers described above thus relate to the more practice-based knowledge perspective. To summarize, this stream of literature regards (environmental) knowledge rather as process then an object, and focuses on for example the importance of not only gaining knowledge but actually understanding knowledge. Focus is also on adaptation to local conditions and context, on creating a supportive context for learning, and on the process of learning, rather than the content of knowledge. Stakeholders, communication and networks are also often mentioned in this type of literature.

4. DISCUSSION & CONCLUSIONS

Although there are different knowledge perspectives and assumptions in the literature on knowledge and capabilities in sustainable product chains the field is clearly dominated by the KM perspective. This implies that most of the literature treats knowledge more objectively, as something that, rather unproblematically, can be extracted from one place to another, and that most of the literature ignores the fact that sharing of knowledge is a much more complex issue. This provides a one-sided approach to the development of capabilities for sustainable product chains since existing literature is dominated by a perception that environmental knowledge can be created and shared without information being lost, misunderstood or ignored in the process. It lacks focus on the importance of adaptation to local company context and specific conditions at individual actors in the product chain.

To provide a theoretical example of the problems of having a KM perspective when it comes to environmental chain management: suppose that a company wants to collaborate with actors up

and downstream its product chains to decrease environmental load from its products, then they might develop an IT based system for sharing environmental knowledge (based on a KM approach). With this system the individual actors can add and extract environmental information that they regard as important. But in practice this activity is more problematic. Information added or extracted to or from the system has been subjected to translation and interpretation. This means that the information considered relevant when added to the system, might not be considered relevant, or may be understood very differently, by the party extracting the information. At each actor there is also different local conditions which has to be considered, this means that focusing only on tools but not on adaptation to local conditions, will probably lead to problems with implementation.

To manage environmental aspects in a life cycle perspective also means to manage those actors involved in the product chains. This is a comprehensive task. Trying to develop organizational capabilities and knowledge for such LCM and sustainable product chains adds to the complexity. When working in a product chain there are many aspects as well as stakeholder relationships to take into consideration. Each of the companies or organizations involved has a different local context and varying conditions, which need to be taken into account. Presupposing that all involved actors will have the same knowledge base and experience is to ignore the complexity of the issue. Therefore the environmental practice-based chain focused approach can contribute greatly to the issue of environmental knowledge sharing and collaboration – especially when it involves several actors, each with specific conditions, in a product chain perspective. Relying on the KM approach might be more relevant in an in-house perspective, when the actors and individuals involved has a similar knowledge-base and values, due to the fact that they are part of the same company culture.

Companies that embark on this path might look to existing literature for advise, and some advice are also to be found. But existing environmental chain related literature is dominated by KM inspired approaches that abstract and simplify, otherwise complex organizing processes. It is therefore my belief that future research on capabilities for LCM would need focus more on practice-based knowing in order to really understand how to develop capabilities for LCM. This means to increase research within the environmental practice-based chain focus, in order to fully understand the development of LCM capabilities.

5. IMPLICATIONS FOR BUSINESS EXECUTIVES

Change towards sustainable product chains is a complex issue without any clear rights or wrongs. Therefore it is not a straightforward road for most companies, but more of trial and error. Looking for answers in existing literature might offer some degree of information on the subject, but this research field still has a lot of room for development and expansion. Looking to the academic field for solutions should also mean to apply a critical approach – to understand that there are several perspectives and approaches in all fields of research and they are not always easy to immediately identity. Having an understanding of the broader context in which literature exists also means to be able to make decisions relevant for the company in question. Understanding that there is different knowledge perspectives present in the field of knowledge and capabilities for sustainable product chains, and having an understanding of these different perspectives, implies that business executives gains a better basis for decision making.

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